UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/782,886	02/13/2001	Alexandre Blais	M-8676 US	3344

20583 7590 04/05/2005		EXAMINER
JONES DAY		HU, SHOUXIANG

ART UNIT	PAPER NUMBER
2811	

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DATE MAILED: 04/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

	Application No.	Applicant(s)
Office Action Summary	09/782,886	BLAIS, ALEXANDRE
	Examiner	Art Unit	
	Shouxiang Hu	2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 November 2004*.

2a)☒ This action is **FINAL**.   2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

    4a) Of the above claim(s) *13-16 and 23-25* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12 and 17-22* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions ·

1.   Newly submitted claims 13-16 and 23-25 are directed to an invention that is distinct from the invention originally claimed for the following reasons: These claims recite and/or implicate certain specific types of qubits and/or gates for the recited computations; while the originally presented claims define a method for quantum computations that does not have to rely on these specific types of qubits and/or gates. Accordingly, these newly submitted claims and the originally presented claims are regarded as being related as between inventions of combination and subcombination.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claim13-16 and 23-25 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03. And, claims 1-12 and 17-22 remain active in this office action.

Claim Objections

2.   Claims 1-12 and 17-22 are objected to because of the following informalities and/or defects:

1, 6 and 22, the term of "method" should read as: method of quantum · computation--.

In claims 4 and 5, the term of "changing" should read as: --the step of changing--

Regarding claims 7-10, claims 7 recites the operations of Z, X, and CP; but it fails

to define what exactly these operations are; instead, they are separately defined in

claims 8-10, respectively. In order to avoid potential confusions, they should be all

defined in a same claim (i.e., claim 7), wherein these operations are first recited.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that

form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3.   Claims 1, 5, 11, 17, 19 and 21, as being best understood in view of the claim

objections above, are rejected under 35 U.S.C. 102(b) as being anticipated by Saito

(Saito et al., Actual computational time-cost of the Quantum Fourier Transform in a

quantum computer using nuclear spins, Los Alamos National Laboratory, preprint

quant-ph/0001113, 2000; of record).

Saito discloses a method for a quantum computation of Fourier Transform (see

Equations 1-10 and Figs. 1 and 2, also see the right column on page 3), naturally

comprising:

(A) obtaining a first series of operations (see Eq. 9 and Fig. 1) for implementation on a quantum computing device comprising a plurality of qubits (a one dimensional array), wherein

(i) quantum interaction between qubits in the plurality of qubits is naturally limited to nearest-neighbor coupling;

(ii) said first series of operations designates a plurality of operations and, for each respective operation in said plurality of operations, a time step in which said respective operation is implemented on the quantum computing device; and

(iii) said first series of operations collectively implements a quantum calculation;

And, as the method of Saito teaches to reduce the number of swaps based on the symmetry of the algorithm under consideration, it naturally also comprises:

(B) deriving a second series of operations from the first series of operations by changing an execution order of a first operation and a second operation in said plurality of operations, otherwise no swaps could be reduced, wherein

(i) the second series of operations is for implementing the quantum calculation on the quantum computing device;

(ii) the first operation and the second operation naturally commute, otherwise they could not be changed in order; and

(iii) said deriving naturally causes a time required for the quantum computing device to complete the second series of operations to be less than a time required for the quantum computing device to complete the first series of operations (see the four paragraphs under Eq. 10).

Claim Rejections - 35 USC § 103

4.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

Claims 2-4, 6-10, 12, 18, 20 and 22, as being best understood in view of the

claim objections above, are rejected under 35 U.S.C. 103(a) as being unpatentable over

Saito in view of Moore (Moore et al., Parallel Quantum Computation and Quantum

Codes, Los Alamos National Laboratory preprint, quant-ph/9808027, v1, August 1998;

of record).

The disclosures of Saito is disclosed as applied to Claims 1, 5, 11, 17, 19 and 21

above.

Although Saito does not expressly disclose that the method can further comprise

performing the first and second operations in a same time step and/or performing two

swaps on two separated sets of qubits simultaneously, one of ordinary skill, which in

this case is familiar with theoretic quantum physics and computer science, would readily

recognize that it is strongly desirable to reduce the computation time through

parallelizing any parallelizable operations, including mutually commutable operations,

as evidenced in Moore (see Propositions 1-6).

Therefore, it would have been obvious to one of ordinary skill in the art at the

time the invention was made to incorporate the parallel computation method of Moore

into the method of Saito, so as to perform the first and second operations in a same

time step and/or perform two swaps on two separated sets of qubits simultaneously, so that a method of quantum computation with reduced computation time would be obtained.

Regarding claims 7-10, it is noted that, as evidenced in AAPA (see Paragraph [0036] of the instant specification), the operations of the recited $Z_r(\pi/2)$, $X_s(\pi/2)$ and/or $CP_{rs}(\pi/2)$ operations are art-known for performing Quantum Fourier Transform; and that individual steps or operation sequences are art-recognized parameters of importance subject to routine experimentation and optimization.

Regarding claim 18, it is noted that computing time as short as O(n) or less is always desirable to the one of ordinary skill in the art, who would use the method collectively taught above to achieve such computation time through routine experimentation and optimization, which would include: omitting every omittable operations and/or swaps, and parallelizing every parallelizable operations and/or swaps.

Response to Arguments

5.   Applicant's arguments filed on 11/15/04 have been fully considered but they are not persuasive. The examiner's response to applicant's arguments regarding Saito has been fully incorporated into the claim rejections set forth above in this office action.

Applicant's arguments regarding Griffiths have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6.   Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).

SH
March 31, 2005

SHOUXIANG HU
PRIMARY EXAMINER